## CLAIMS

1. (Amended) A model of compact adult bone, wherein ~~said~~ the model comprises the viscoelastic properties of at least one type of an ~~a secondary~~ osteon,

wherein each viscoelastic property is correlated with at least one component of bone microstructure and ultrastructure, and components are grouped hierarchically to provide a description of one or more characteristics of the bone.

2. (Amended) The model of claim 1, wherein ~~said secondary~~ the osteon is a longitudinal osteon or an alternate osteon.

3. (Original) The model of claim 1, wherein the viscoelastic properties comprises at least one parameter selected from the group consisting of mechanical properties, collagen content, mucopolysaccharide content, hydroxyapatite content, collagen bundle orientation relative to osteon axis, osteocyte content, osteoblast content, and content of porosity fluids.

4. (Original) The model of claim 3 wherein the viscoelastic properties comprises mechanical properties, collagen content, mucopolysaccharide content, hydroxyapatite content, and collagen bundle orientation relative to osteon axis.

5. (Original) The model of claim 3, wherein osteon mechanical properties comprises an angle-of-twist as a function of torque, osteon hydroxyapatite content, strain rate, or time.

6. (Original) The model of claim 5, wherein the angle-of-twist as a function of torque is derived from tests conducted under monotonic or dynamic loading.

7. (Original) The model of claim 5, wherein angle-of-twist as a function of torque at an approximately constant strain rate and approximately constant hydroxyapatite content is represented by a Ramgood-Osgood equation.

8. (Original) The model of claim 7, wherein a higher hydroxyapatite content leads to a higher angle-of-twist as a function of torque.

9. (Original) The model of claim 7, wherein a higher strain rate leads to a higher angle-of-twist as a function of torque.

10. (Amended) The model of claim 1, comprising the viscoelastic properties of longitudinal and ~~secondary~~ alternate osteons.

11. (Original) The model of claim 10, wherein the viscoelastic properties comprises mechanical properties, collagen content, mucopolysaccharide content, hydroxyapatite content, and collagen bundle orientation relative to osteon axis.

12. (Original) The model of claim 11, wherein the ratio of collagen and mucopolysaccharides in longitudinal osteons as compared to collagen and mucopolysaccharides in alternate osteons is less than 1 for longitudinal and alternate osteons with approximately equal hydroxyapatite contents.

13. (Original) The model of claim 1, wherein the internal diameter of a reference osteon is about 40 $\mu$m, the external diameter of the reference osteon is about 210 $\mu$m, and the height of the reference osteon is about 500 $\mu$m.

14. (Original) The model of claim 13, wherein a longitudinal reference osteon comprises about 12 laminae.

15. (Original) The model of claim 13, wherein an alternate reference osteon comprises about 36 laminae.

16. (Original) The model of claim 1, comprising a Finite Element Model (FEM).

17. (Amended) A method of predicting deformation and fractures of compact adult bone comprising using a model of compact adult bone, wherein ~~said~~ the model comprises the viscoelastic properties of ~~secondary~~ longitudinal and alternate osteons,

wherein each viscoelastic property is correlated with at least one component of bone microstructure and ultrastructure, and components are grouped hierarchically to provide a description of one or more characteristics of the bone.

18. (Original) The method of claim 17, wherein the model simulates fracture propagation by calculating stress distribution as a function of a torque applied to the bone.

19. (Original) A method of identifying the requirements of bone reconstruction and prosthesis using the model of claim 1.

20. (Amended) A method of preparing a model of the viscoelastic properties of bone, wherein ~~said~~ the method comprises determining viscoelastic properties of alternate and longitudinal osteons.

21. (Original) The method of claim 20, wherein viscoelastic properties comprises mechanical properties, collagen content, mucopolysaccharide content, hydroxyapatite content, and collagen bundle orientation relative to osteon axis.

22. (Original) The method of claim 21, wherein the mechanical properties are determined by evaluating angle-of-twist as a function of torque, osteon hydroxyapatite content, strain rate, or time.

23. (Original) The method of claim 22, wherein angle-of-twist as a function of torque is determined by quasi-static torsional loading to rupture.

24. (Original) The method of claim 21, comprising determining the ratio of collagen and mucopolysaccharides in a longitudinal osteon as compared to those of an alternate osteon by the following method: (i) drying the longitudinal and alternate osteons to constant weight; (ii) separately contacting the longitudinal and alternate osteons with acid to promote the hydrolysis of collagen to hydroxyproline and mucopolysaccharides to hexosamine; and (iii) separating hydroxyproline from hexosamine; and (iv) determining the ratio of hydroxyproline and hexosamine in the longitudinal osteon as compared to the alternate osteon; wherein the ratio of hydroxyproline and hexosamine in the longitudinal osteon as compared to the alternate osteon corresponds to the ratio of collagen and mucopolysaccharides in the longitudinal osteon as compared to the alternate osteon.

25. (Original) The method of claim 24, wherein the ratio of collagen and mucopolysaccharides in a longitudinal osteon as compared to an alternate osteon is less than 1, for a longitudinal and alternate osteon with approximately equal hydroxyapatite contents.

26. (Original) The method of claim 21, wherein the collagen-bundle direction related to osteon axis is determined by circularly polarizing light microscopy, confocal microscopy or X-ray diffraction.